



The Abdus Salam  
**International Centre  
for Theoretical Physics**  
50th Anniversary 1964–2014



**Workshop on Coherent Phenomena in Disordered Optical Systems  
26 - 30 May 2014, Trieste, Italy**

**Momentum Space Signatures of Anderson Localization**

**Cord MÜLLER**

Department of Physics, Universität Konstanz  
D-78457 Konstanz, Germany

Abstract:

While Anderson localisation is well known to suppress the real-space diffusion of (matter) waves, much less is known about momentum-space signatures. In this talk, I describe a new signature of strong Anderson localization that has been discovered for ultracold atoms released into an optical disorder potential: a twin-peak signal in the particles' momentum distribution [1]. The backscattering peak is an expected consequence of weak localisation, but the forward scattering peak appears to be a genuine signal for the onset of strong localisation. Recent non-perturbative calculations in a quasi-1D setting [2] have confirmed that the forward peak can serve as a reliable signature of Anderson localisation effects, from its temporal genesis all the way to its asymptotic long-time behaviour. Furthermore, I show how the controlled dephasing of free propagation by external fields permits to distinguish phase-coherent from phase-incoherent transport processes.

[1] T. Karpiuk et al., PRL 109, 190601 (2012)

[2] T. Micklitz et al., PRL 112, 110602 (2014)